

## PHYSICAL CONSTANTS (SI)<sup>7</sup>

| Physical Quantity              | Symbol                                       | Value                    | Units                                   |
|--------------------------------|--|--------------------------|---|
| Boltzmann constant             | $k$  | $1.3807 \times 10^{-23}$ | $\text{JK}^{-1}$                        |
| Elementary charge              | $e$  | $1.6022 \times 10^{-19}$ | C                                       |
| Electron mass                  | $m_e$  | $9.1094 \times 10^{-31}$ | kg                                      |
| Proton mass                    | $m_p$  | $1.6726 \times 10^{-27}$ | kg                                      |
| Gravitational constant         | $G$  | $6.6726 \times 10^{-11}$ | $\text{m}^3\text{s}^{-2}\text{kg}^{-1}$ |
| Planck constant                | $h$  | $6.6261 \times 10^{-34}$ | $\text{Js}$                             |
|                                | $\hbar = h/2\pi$                             | $1.0546 \times 10^{-34}$ | $\text{Js}$                             |
| Speed of light in vacuum       | $c$  | $2.9979 \times 10^8$     | $\text{ms}^{-1}$                        |
| Permittivity of free space     | $\epsilon_0$                                 | $8.8542 \times 10^{-12}$ | $\text{F m}^{-1}$                       |
| Permeability of free space     | $\mu_0$                                      | $4\pi \times 10^{-7}$    | $\text{H m}^{-1}$                       |
| Proton/electron mass ratio     | $m_p/m_e$                                    | $1.8362 \times 10^3$     |   |
| Electron charge/mass ratio     | $e/m_e$                                      | $1.7588 \times 10^{11}$  | $\text{C kg}^{-1}$                      |
| Rydberg constant               | $R_\infty = \frac{me^4}{8\epsilon_0^2 ch^3}$ | $1.0974 \times 10^7$     | $\text{m}^{-1}$                         |
| Bohr radius                    | $a_0 = \epsilon_0 h^2 / \pi m e^2$           | $5.2918 \times 10^{-11}$ | m                                       |
| Atomic cross section           | $\pi a_0^2$                                  | $8.7974 \times 10^{-21}$ | $\text{m}^2$                            |
| Classical electron radius      | $r_e = e^2 / 4\pi\epsilon_0 mc^2$            | $2.8179 \times 10^{-15}$ | m                                       |
| Thomson cross section          | $(8\pi/3)r_e^2$                              | $6.6525 \times 10^{-29}$ | $\text{m}^2$                            |
| Compton wavelength of electron | $h/m_e c$                                    | $2.4263 \times 10^{-12}$ | m                                       |
|                                | $\hbar/m_e c$                                | $3.8616 \times 10^{-13}$ | m                                       |
| Fine-structure constant        | $\alpha = e^2 / 2\epsilon_0 hc$              | $7.2974 \times 10^{-3}$  |   |
|                                | $\alpha^{-1}$                                | 137.04                   |   |
| First radiation constant       | $c_1 = 2\pi hc^2$                            | $3.7418 \times 10^{-2}$  | $\text{W m}^2$                          |
| Second radiation constant      | $c_2 = hc/k$                                 | $1.4388 \times 10^{-2}$  | mK                                      |
| Stefan-Boltzmann constant      | $\sigma$                                     | $5.6705 \times 10^{-8}$  | $\text{W m}^{-2}\text{K}^{-4}$          |

| Physical Quantity                         | Symbol                   | Value                    | Units                             |
|---|--------------------------|--------------------------|-----------------------------------|
| Wavelength associated with 1 eV           | $\lambda_0 = hc/e$       | $1.2398 \times 10^{-6}$  | m                                 |
| Frequency associated with 1 eV            | $\nu_0 = e/h$            | $2.4180 \times 10^{14}$  | Hz                                |
| Wave number associated with 1 eV          | $k_0 = e/hc$             | $8.0655 \times 10^5$     | $\text{m}^{-1}$                   |
| Energy associated with 1 eV               | $h\nu_0$                 | $1.6022 \times 10^{-19}$ | J                                 |
| Energy associated with $1 \text{ m}^{-1}$ | $hc$                     | $1.9864 \times 10^{-25}$ | J                                 |
| Energy associated with 1 Rydberg          | $me^3/8\epsilon_0^2 h^2$ | 13.606                   | eV                                |
| Energy associated with 1 Kelvin           | $k/e$                    | $8.6174 \times 10^{-5}$  | eV                                |
| Temperature associated with 1 eV          | $e/k$                    | $1.1604 \times 10^4$     | K                                 |
| Avogadro number                           | $N_A$                    | $6.0221 \times 10^{23}$  | $\text{mol}^{-1}$                 |
| Faraday constant                          | $F = N_A e$              | $9.6485 \times 10^4$     | $\text{C mol}^{-1}$               |
| Gas constant                              | $R = N_A k$              | 8.3145                   | $\text{J K}^{-1} \text{mol}^{-1}$ |
| Loschmidt's number (no. density at STP)   | $n_0$                    | $2.6868 \times 10^{25}$  | $\text{m}^{-3}$                   |
| Atomic mass unit                          | $m_u$                    | $1.6605 \times 10^{-27}$ | kg                                |
| Standard temperature                      | $T_0$                    | 273.15                   | K                                 |
| Atmospheric pressure                      | $p_0 = n_0 k T_0$        | $1.0133 \times 10^5$     | Pa                                |
| Pressure of 1 mm Hg (1 torr)              |                          | $1.3332 \times 10^2$     | Pa                                |
| Molar volume at STP                       | $V_0 = RT_0/p_0$         | $2.2414 \times 10^{-2}$  | $\text{m}^3$                      |
| Molar weight of air                       | $M_{\text{air}}$         | $2.8971 \times 10^{-2}$  | kg                                |
| calorie (cal)                             |                          | 4.1868                   | J                                 |
| Gravitational acceleration                | $g$                      | 9.8067                   | $\text{m s}^{-2}$                 |